



Case report

Traumatic acute myocardial ischaemia involving two vessels



Nemanja Radojevic, MD, MSc, Forensic Pathologist^{a,*},
Miroslav Radunovic, MD, PhD, Anatomist^{b,c}

^a Department of Forensic Medicine, Clinical Centre of Montenegro, Faculty of Medicine, University of Montenegro, Ljubljanska 1, 20000 Podgorica, Montenegro

^b Department of Anatomy, Faculty of Medicine, University of Montenegro, Ljubljanska 1, 20000 Podgorica, Montenegro

ARTICLE INFO

Article history:

Received 9 October 2013

Received in revised form

23 December 2013

Accepted 19 January 2014

Available online 25 January 2014

Keywords:

Acute myocardial infarction

Coronary artery injury

Blunt chest trauma

Coronary dissection

ABSTRACT

Myocardial infarctions caused by coronary artery injury after blunt chest trauma is a fatal, but rare occurrence. In the case reported on here, a fatally injured 69-year-old male driver sustained such trauma in a frontal car collision. The autopsy found a laceration of the left anterior descending artery as well as a subsequent subepicardial haematoma surrounding this artery and the circumflex artery. Using triphenyl tetrasodium chloride and hematoxylin-eosin stains, an acute myocardial ischaemia of the anterior left ventricle wall and the septum was diagnosed as the cause of death. Since coronary injuries affecting more than one vessel in blunt chest trauma are extremely rare, only a few papers have yet to refer to this type of coronary injury in addition to the case presented here.

© 2014 Elsevier Ltd and Faculty of Forensic and Legal Medicine. All rights reserved.

Introduction

Fatally injured car occupants from frontal collisions are a common phenomenon in daily forensic practise. The most frequent causes of death include craniocerebral injuries and injuries of the thoraco-abdominal organs with consecutive fatal bleeding.¹ The fast deceleration of the driver's body in frontal collisions generally leads to inertia continuing the movement of the body to collide with the steering wheel, the airbag, or the front windshield.

Among the fatally injured, the locus resistentiae minoris in the central mediastinum are the aorta and the lungs, usually followed by sternal and rib fractures. Heart injuries are not as frequent since the organ is protected by the sternum. However, when they do occur, ruptures of the heart wall lead to cardiac tamponade and to death. In addition to fatal cardiac ruptures, heart contusion and commotio cordis may be followed by arrhythmia, and heart failure, which also sometimes prove fatal.^{2,3} Since myocardial infarctions caused by coronary artery dissection after blunt chest trauma are rare,⁴ only a few cases of fatal and non-fatal coronary artery injuries in blunt chest trauma have been described in the literature.

The left main coronary artery (LMCA) branches into the circumflex artery (CA), and the left anterior descending artery (LAD). The CA supplies blood to the left atrium, the side, and the back of the left ventricle, while the LAD supplies the front and bottom of the left ventricle, as well as the front of the septum. Therein, in the case under review here, an unusual fatal outcome of a driver from a frontal car collision is presented, in which an LAD laceration and subsequent acute myocardial infarction occurred.

Case report

According to the police report and the passengers' testimonies, a 69-year-old male driver died just 5–10 min after a car accident in which his vehicle collided into a tree alongside the road. No cardiopulmonary resuscitation was performed on the man. After the accident, the steering wheel was found to have become deformed. The car was an old Volkswagen model that had no airbag installed.

An outer examination of the body showed a congested head and neck with a few frontal excoriations and small haematomas on both knees. The autopsy showed a subepicardial haematoma (approximately 3 × 3 × 1 cm) in the upper third of the anterior heart wall (Fig. 1). At a distance of 13 mm from the bifurcation of the LMCA, a 3 mm long transversal laceration of the LAD was noted on the longitudinal cut of the artery. A haematoma was formed by the exsanguinated blood from the LAD laceration, which surrounded the LAD and the CA by approximately 3 cm of their lengths. On the

* Corresponding author. Tel.: +382 69 340 510.

E-mail addresses: com_nr@yahoo.com (N. Radojevic), miro@t-com.me (M. Radunovic).

^c Tel.: +382 69 344 822.

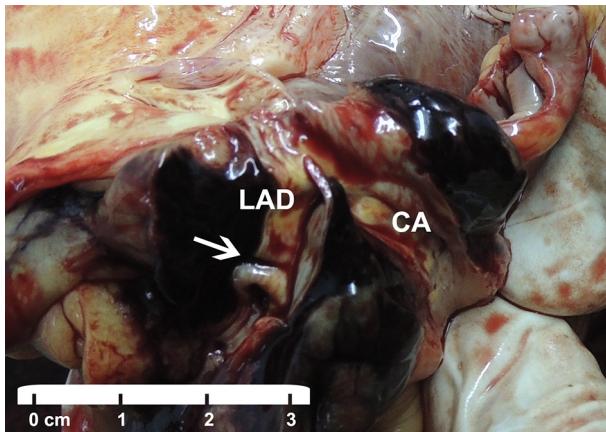


Fig. 1. Subepicardial haematomas surrounding the left anterior descending artery (LAD) and the circumflex artery (CA). The arrow indicates the laceration of the artery.

inner surface of the coronary arteries, a slight atherosclerosis was observed, but without any occlusion narrower than 50%. In the region of the anterior left ventricle's wall and the septum, a pale ischaemic myocardial zone approximately 4×5 cm in diameter was noted. In addition to the heart injury, others were found: a transversal sternal fracture at the level between the insertion of the third and fourth ribs; a 7 mm long anterior pericardial laceration containing 40 mL of blood in its pericardial sac; anterior serial bilateral fractures of the ribs; and a large liver laceration ($10 \times 4 \times 4$ cm) accompanied by 100 mL of exsanguinated blood into the peritoneal cavity. All other organs were normal in their macroscopical appearance.

Using triphenyl tetrazolium chloride, the pale ischaemic zone of the myocardium expressed a positive reaction. A microscopical examination of the same area, using haematoxylin-eosin stains, revealed only a few zones of peripheral undulation of rare fragmented myofibres. Other regions of the heart, as well as all other tissues and organs, showed no significant changes histopathologically.

Discussion

Heart injuries caused by accidental car collisions encompass a spectrum of pathology ranging from clinically silent and transient dysrhythmias to the most frequent deadly outcomes.⁵ Chest pain is a common symptom after blunt chest injury, which may relate to chest contusions without any cardiac injury, or a myocardial infarction.⁴ The differentiation between a slight thoracic contusion and a significant cardiac injury is a challenge for any physician when attempting to assign an early diagnosis of a traumatic heart injury. The causative mechanisms of coronary artery injuries after blunt chest trauma are hypothesized to be vascular spasms,⁶ most often dissection^{3,5,7–10} and intimal tears caused by the shearing forces involved and the compression of the artery between the heart and the sternum, which lead to coronary artery dissection, or even a rupture of an existing plaque within the thrombus formation.^{11–14} Autopsy studies have revealed that the incidence of coronary artery injuries secondary to blunt chest trauma to be around 2%,¹⁵ stemming from the fact that coronary artery injuries resulting in myocardial infarction are an extremely rare complication of blunt chest trauma.⁴ Lima et al.,¹⁴ and Shao et al.⁹ have reported on a case of congestive cardiac failure related to coronary injury that had developed a month after the original blunt chest trauma.

In the case under review here, after the frontal collision with the tree, the driver experienced blunt chest trauma by colliding with the steering wheel. The fractured parts of the sternum lacerated the pericardium and the LAD, producing a subepicardial haematoma which surrounded the LAD and the CA. The strangulation of the coronary arteries by the surrounding haematoma and the vascular spasm that resulted from the artery laceration both lead to a fatal myocardial ischaemia, which was confirmed macroscopically and microscopically. According to the witness testimonies, the death was rapid; therefore, the most probable mechanism of death was a fatal arrhythmia. Since the heart sustained a blunt injury, it's contusion or commotion also might lead to the deadly arrhythmia, but the ischaemic zones of the myocardium confirmed by triphenyl tetrazolium chloride and microscopical examination strengthen the theory of ischaemic rather than direct injury related death.

Christensen et al.¹⁷ have found the LAD to be the most commonly affected vessel (71.4%), followed by the right coronary artery (19%), the LMCA (6.4%), and the CA (3.2%). Coronary injuries affecting more than one vessel in blunt chest trauma are extremely rare, and, in addition to this case presented here, only a few papers have yet to refer to this type of coronary injury.^{9,18,19}

Ethical approval

None declared.

Funding

None.

Conflict of interests

As it is based on the case from daily autopsy practise, authors did not have any support funding of the paper.

Authors did not have any financial benefits on publishing the paper, nor conflict of interests.

References

1. DiMaio V, DiMaio D. *Forensic pathology*. 2nd ed. Boca Raton, FL: CRC Press; 2001.
2. Bock JS, Benitez RM. Blunt cardiac injury. *Cardiol Clin* 2012;30:545–55.
3. Monsefi N, Moritz A, Dzemali O. Acute dissection of the left anterior descending after contusio cordis. *J Cardiovasc Surg (Torino)* 2011;52:293–5.
4. Lin YL, Yu CH. Acute myocardial infarction caused by coronary artery dissection after a blunt chest trauma. *Intern Med* 2011;50:1969–71.
5. Al-Aqeedi RF, Ali WM, Al-Ani F, Abdulrahman YS, Alnabti A. A blunt chest trauma causing left anterior descending artery dissection and acute myocardial infarction treated by deferred angioplasty. *Heart Views* 2011;12:71–3.
6. Díaz-Méndez M, Vázquez-Cortés JA, Flores-Arenas JR, Rábago-Escoto Rdel C. Chest blunt trauma associated with myocardial infarction. Case report. *Rev Med Inst Mex Seguro Soc* 2010;48:563–6.
7. Dobiás M, Hejna P, Mawiri AA. Coronary artery dissection: a fatal complication following blunt chest trauma. *Forensic Sci Med Pathol* 2013;9:454–7.
8. Hamonic Y, Biais M, Naibo D, Revel P, Sztark F. Coronary artery dissection complicated by myocardial infarction in a head trauma patient. *Ann Fr Anesth Reanim* 2012;31:553–6.
9. Shao Y, Xia W, Zhang C, Wang X. Bilateral coronary dissection after blunt thoracic trauma: a case report. *Can J Cardiol* 2012;28:515.
10. Lobay KW, MacGougan CK. Traumatic coronary artery dissection: a case report and literature review. *J Emerg Med* 2012;43:e239–43.
11. Pringle SD, Davidson KG. Myocardial infarction caused by coronary artery damage from blunt chest injury. *Br Heart J* 1987;57:375–6.
12. Özdogan Ö, Karaçelik M, Ekmekçi C, Özbek C. Management of acute myocardial infarction after a blunt chest trauma. *Ulus Travma Acil Cerrahi Derg* 2013;19:173–6.
13. Halboos A, Jacksch R. Subacute anterior myocardial infarction after mild blunt chest trauma in a 32-year-old man. *Dtsch Med Wochenschr* 2012;137:214–6.
14. Sun L, Li ZA, Zhao Y, Han J, Henein MY. Left anterior descending artery occlusion secondary to blunt chest trauma diagnosed by comprehensive echocardiography and coronary angiography. *J Clin Ultrasound* 2012;40:370–4.
15. Prete R, Chilcott M. Blunt trauma to the heart and great vessels. *N Engl J Med* 1997;336:626–32.

17. Christensen MD, Nielsen PE, Sleight P. Prior blunt chest trauma may be a cause of single vessel coronary disease; hypothesis and review. *Int J Cardiol* 2006;108:1–5.
18. Lai CH, Ma T, Chang TC, Chang MH, Chou P, Jong GP. A case of blunt chest trauma induced acute myocardial infarction involving two vessels. *Int Heart J* 2006;47:639–43.
19. da Silva AC, de Paula JE, Mozer GW, Toledo LF, Soares RL, Albertal M. Simultaneous dissection and intramural hematoma of left anterior descending and circumflex coronary arteries after blunt chest trauma. *Int J Cardiol* 2012;155: e34–6.